

FORM PTO-1390
(REV. 1-98)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371

2694-0131P

U.S. APPLICATION NO. (If known, see 37 CFR 1.5)

09/744 809

INTERNATIONAL APPLICATION NO.

PCT/EP99/05272

INTERNATIONAL FILING DATE

July 23, 1999

PRIORITY DATE CLAIMED

July 30, 1998

TITLE OF INVENTION

A PROCESS FOR THE MICROBIAL LEACHING OF SULFIDIC MATERIALS, AND THE USE OF SULFUR-*

APPLICANT(S) FOR DO/EO/US

ROJAS-CHAPANA, Jose; TRIBUTSCH, Helmut;

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39 (1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
 - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☒ has been transmitted by the International Bureau. WO 00/06785
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(3)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(2))
 - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☒ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98./International Search Report (PCT/ISA/210)
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.
☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information:
 - 1.) One (1) sheet of Formal Drawings

*CONTAINING AMINO ACIDS IN SAID MICROBIAL LEACHING

U.S. APPLICATION NO. 09/744809 NEW		INTERNATIONAL APPLICATION NO. PCT/EP99/05272		ATTORNEY'S DOCKET NUMBER 2694-0131P	
17. <input checked="" type="checkbox"/> The following fees are submitted: BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5): Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO. \$1,000.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO \$860.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO. \$710.00 International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) \$690.00 International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4). \$100.00 ENTER APPROPRIATE BASIC FEE AMOUNT =				CALCULATIONS PTO USE ONLY	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input checked="" type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$ 130.00	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total Claims	8 - 20 =	0	X \$18.00	\$ 0	
Independent Claims	2 - 3 =	0	X \$80.00	\$ 0	
MULTIPLE DEPENDENT CLAIM(S) (if applicable) None			+ \$270.00	\$ 0	
TOTAL OF ABOVE CALCULATIONS =				\$ 990.00	
Reduction of 1/2 for filing by small entity, if applicable. Applicant claims Small Entity Status in accordance with 37 CFR 1.27.				\$ 0	
SUBTOTAL =				\$ 990.00	
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$ 0	
TOTAL NATIONAL FEE =				\$ 990.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property +				\$ 0	
TOTAL FEES ENCLOSED =				\$ 990.00	
				Amount to be:	
				refunded	\$
				charged	\$

- a. ☒ A check in the amount of \$ 990.00 to cover the above fees is enclosed.
- b. ☐ Please charge my Deposit Account. No. _____ in the amount of \$ _____ to cover the above fees.
A duplicate copy of this sheet is enclosed.
- c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 02-2448.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

Send all correspondence to:

Birch, Stewart, Kolasch & Birch, LLP or Customer No. 2292
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 SIGNATURE

MUNCY, JOE MCKINNEY
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#32,334 (KM)
 REGISTRATION NO.

09/744809
PATENT

2694-0131P

JC07 Rec'd PCT/PTO

30 JAN 2001

IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicant: ROJAS-CHAPANA, Jose et al. Conf.:
Int'l. Appl. No.: PCT/EP99/05272
Appl. No.: New Group:
Filed: January 30, 2001 Examiner:
For: A PROCESS FOR THE MICROBIAL LEACHING OF
SULFIDIC MATERIALS, AND THE USE OF SULFUR-
CONTAINING AMINO ACIDS IN SAID MICROBIAL
LEACHING

PRELIMINARY AMENDMENT

BOX PATENT APPLICATION

Assistant Commissioner for Patents
Washington, DC 20231

January 30, 2001

Sir:

The following Preliminary Amendments and Remarks are respectfully submitted in connection with the above-identified application.

AMENDMENTS

IN THE SPECIFICATION:

Please amend the specification as follows:

Before line 1, insert --This application is the national phase under 35 U.S.C. § 371 of PCT International Application No. PCT/EP99/05272 which has an International filing date of July 23, 1999, which designated the United States of America.--

IN THE CLAIMS:

Please amend the claims as follows:

Claim 4: Line 1, change "any of claims 1 to 3" to

--claim 1--

Claim 5: Line 1, change "any of claims 1 to 4" to
--claim 1--

Claim 6: Line 1, change "any of claims 1 to 5" to
--claim 1--

REMARKS

The specification has been amended to provide a cross-reference to the previously filed International Application. The claims have also been amended to delete multiple dependencies and to place the application into better form for examination. Entry of the present amendment and favorable action on the above-identified application are earnestly solicited.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By 

Joe McKinney Muncy, #32,334

KM/cqc
2694-0131P

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(Rev. 01/22/01)

**A Process for the Microbial Leaching of Sulfidic Materials,
and the Use of Sulfur-containing Amino Acids
in Said Microbial Leaching**

Specification

THE FTD 50377260

The invention relates to an effective and environmentally safe process for the microbial leaching of sulfidic materials, particularly of sulfide ores such as pyrite, marcasite, chalcopyrite, bornite, or covellite, which process is characterized in that the aqueous leaching fluid is added with sulfur-containing amino acids or derivatives thereof. The invention is also directed to the use of sulfur-containing amino acids or derivatives thereof in the microbial leaching of sulfidic materials, particularly in pyrite leaching.

Microbial leaching is a well-known process in biohydrometallurgy for leaching out metals from ores and other mineral raw materials through the action of microorganisms. Obligatorily chemolithoautotrophic *Thiobacillus* species such as *T. ferrooxidans* and *T. thiooxidans* whose energy sources are sulfides, elemental sulfur and soluble thio-sulfates, but also iron(II) ions as an alternative, play a central role in the chemistry of ore leaching. In any case, the microbial action leads up to the sulfate. As an example, reference is made to US 2,829,964 wherein a cyclic leaching process using iron-oxidizing bacteria is described. In this process, the ore is leached with a sulfuric Fe(III) sulfate solution obtained using bacteria. Thereafter, leach and gangue are separated, the leach metal

content is extracted, and the Fe(II)-containing final leach is re-oxidized using bacteria.

The literature also suggests a number of processes to improve ore leaching and, in particular, to increase the leaching rate, which processes, above all, envisage the use of surface-active substances (D.W. Duncan, P.C. Trussell, and C.C. Walden, Leaching of Chalcopyrite with *Thiobacillus ferrooxidans*: Effect of Surfactants and Shaking, 1964, Applied Microbiology 12(2), 122-126; I. Palencia, F. Caranza, and J. Pereda, Influence of Block Copolymers on the Microbiological Leaching of Pyrites by Discontinuous Operation, 1984, Tenside Detergents 21(2), 90-93; N. Wakao, M. Mishina, Y. Sakurai, and H. Shiota, Bacterial Pyrite Oxidation III. Adsorption of *Thiobacillus ferrooxidans* Cells on Solid Surfaces and Its Effects on Iron Release from Pyrite, 1984, J. Gen. Appl. Microbiol. 30, 63-67).

It is believed that these substances - chiefly surfactants or polysaccharides and peptides or proteins - improve the contact between bacteria and sulfide, thereby facilitating bacterial attack.

However, the surfactants that are used are disadvantageous because they have lacking or low biodegradability and do not represent environmentally safe substances. Peptides and proteins as surface-active compounds exhibit controversial effects in the leaching process.

It was therefore the object of the present invention to provide an effective leaching process with improved dissolution rate without the use of environmentally hazardous additives.

Surprisingly, it has now been found that bacterial attack by *Thiobacillus* species on sulfidic materials can be

greatly accelerated by adding the aqueous leaching fluid with an amino acid, selected from cysteine, methionine, or derivatives thereof, or a mixture of these compounds at low concentration.

More specifically, homocysteine and amides or esters of cysteine, methionine or homocysteine are possible as derivatives which can be used in the leaching process according to the invention. Homocysteine is a derivative of methionine wherein the methyl group on the sulfur has been replaced by hydrogen, so that homocysteine - like cysteine - has a sulfhydryl group. According to the invention, both racemates and optically active forms of the amino acids may find use.

It has been found that an optimum effect is achieved in those cases where the concentration of the added amino acid(s) or derivatives thereof in the aqueous leaching fluid is low, not exceeding 8×10^{-3} M, in particular. Concentrations of from 8×10^{-4} to 8×10^{-5} M are particularly preferred. The pH value of the leaching fluid is adjusted to 1.0-4.0, preferably to 1.5-2.0, and more preferably to 1.6. Adjustment is effected using suitable buffer solutions, e.g. Tuovinen buffer (Arch. Mikrobiol, 88, 285-298 (1973)).

According to the invention, there are two possible ways of performing the leaching process. On the one hand, the leaching fluid may include both the *Thiobacillus* species and the sulfur-containing amino acids or derivatives thereof. This embodiment is the preferred one. Alternatively, it is also possible to use the dilute amino acid solution alone as leaching fluid and subsequently add the thiobacilli to the discharging fluid (e.g. outside the dump) which is recycled. These two possible ways do not exclude the principal methods of ore leaching well-known to

those skilled in the art, i.e., slope leaching, dump leaching or *in situ* leaching. In practice, the process according to the invention can be used with any of the three ore leaching processes.

According to the invention, *T. ferrooxidans* is preferred as *Thiobacillus* species. This strain is acidophilic, occurring in acidic waters of ore mines. Detailed investigations relating to the growth of this strain have also been described by Tuovinen O.H. et al. in Arch. Mikrobiol. 88, 285-298 (1973).

Thus, the process of the invention provides an effective method of ore leaching, particularly of pyrite, which process, in contrast to current methods such as cyanide leaching, does not represent any risk for the ecological balance of the environment. The amino acids and their derivatives used according to the invention are environmentally safe and inexpensive starting materials. They are employed at exceedingly low concentrations and result in an essential improvement of bacterial dissolution of metal sulfides (e.g. FeS_2). Thus, for example, the process according to the invention permits speeding up the microbial recovery of copper or gold from pyrite ores.

The invention is also directed to the novel use of sulfur-containing amino acids, derivatives or mixtures thereof in the microbial leaching of sulfidic materials, particularly of sulfide ores.

With reference to the embodiments, the invention will be illustrated in more detail below.

Embodiments

Example 1:

Preparation of pyrite layers using a low-pressure MOCVD plant (metal-organic chemical vapor deposition)

The metal-organic chemical vapor deposition (MOCVD) is a process for preparing thin polycrystals and epitaxial layers, said layers being deposited from the gaseous phase. Organometallic compounds are mostly used as starting materials (precursors). The deposition process proceeds as follows: A carrier gas is passed through so-called bubblers. The bubbler contains the organometallic compounds in liquid or solid form. As a result, the starting materials are taken up by the carrier gas. The starting compounds are passed over a heated substrate by the carrier gas. The starting compounds include the elements which are to form the layer. The compounds undergo decomposition over the substrate surface in a reaction. As a result, the elements contributing to layer formation are liberated. These elements attach to the substrate surface, thereby forming the layer. Excess decomposition products are conveyed to the vent air by the carrier gas. In the present Example, the pyrite layers are prepared using an MOCVD plant as described in "Solar Energy Materials and Solar Cells" 1993, 29, 289-370. Elemental sulfur was used as suitable sulfur precursor. In the preparation of pyrite, iron pentacarbonyl $[\text{Fe}(\text{CO})_5]$ was used as iron precursor.

Example 2:

Acceleration of bacterial dissolution of pyrite layers with Thiobacillus ferrooxidans in the presence of cysteine

Each time, 1 cm^2 of pyrite layers 100 nm in thickness (referred to as $\text{S}^0\text{-FeS}_2$), prepared according to Example 1 using elemental sulfur as precursor, was added with

300 μ l of aqueous solutions or suspensions of *Thiobacillus ferrooxidans* cells and cysteine at concentrations of from 8×10^{-2} to 8×10^{-5} M in an *in situ* pyrite culture chamber. The pH value of the solutions was adjusted to 1.6 using Tuovinen buffer (for 1 liter: $\text{KH}_2\text{PO}_4 = 0.4$ g, $\text{MgSO}_4 \cdot 7\text{H}_2\text{O} = 0.4$ g, $(\text{NH}_4)_2\text{SO}_4 = 0.4$ g, $\text{FeSO}_4 \cdot 7\text{H}_2\text{O} = 33.3$ g, with no iron(II) being added) [cf., Tuovinen and Kelly, Arch. Mikrobiol. 88, 285-298 (1973)].

Fig. 1 is a plot of the pyrite corrosion level (or dissolution rate) [%] as a function of time [days] for the various solutions. Clearly, the bacterial pyrite dissolution rate is highly accelerated in the presence of a sulfur-containing amino acid at concentrations below 8×10^{-3} M. At concentrations of 8×10^{-4} M and 8×10^{-5} M cysteine in the solution, a lag phase no longer occurs, and a pyrite corrosion level of 100% is achieved after only 10-11 days.

Claims:

1. A process for the microbial leaching of sulfidic materials using microorganisms of the *Thiobacillus* genus, characterized in that the leaching fluid includes an amino acid selected from cysteine, methionine or derivatives thereof, or a mixture of said compounds.
2. The process according to claim 1, characterized in that the leaching fluid includes both the microorganisms of the *Thiobacillus* genus and the amino acid or derivatives thereof or a mixture of these compounds.
3. The process according to claim 1, characterized in that the leaching fluid includes the amino acid or derivatives thereof or a mixture of said compounds, and the microorganisms of the *Thiobacillus* genus are added to the discharging fluid.
4. The process according to any of claims 1 to 3, characterized in that the concentration of amino acid, amino acid derivative or of the mixture in the aqueous leaching fluid is $\leq 8 \times 10^{-3}$ M.
5. The process according to any of claims 1 to 4, characterized in that the pH value of the leaching fluid is adjusted to 1-4, preferably to 1.5-2.0.
6. The process according to any of claims 1 to 5, characterized in that *T. ferrooxidans* is used as *Thiobacillus* species.
7. Use of an amino acid selected from cysteine, methionine, or derivatives thereof, or a mixture of

**A Process for the Microbial Leaching of Sulfidic Materials
and Use of Sulfur-containing Amino Acids
in Said Microbial Leaching**

Abstract:

The invention relates to an effective and environmentally safe process for the microbial leaching of sulfidic materials, particularly of sulfide ores such as pyrite, marcasite, chalcopyrite, bornite, or covellite, which process is characterized in that the aqueous leaching fluid is added with sulfur-containing amino acids or derivatives thereof. The invention is also directed to the use of sulfur-containing amino acids or derivatives thereof in the microbial leaching of sulfidic materials, particularly in pyrite leaching.

said compounds in the microbial leaching of sulfidic materials.

8. The use according to claim 7, characterized in that the sulfidic materials are sulfide ores, preferably pyrite.

Figure 1 consists of 18 small plots, labeled (a) through (r), arranged in a grid. Each plot shows the effect of a specific factor on the growth of *E. coli*. The y-axis for most plots represents a growth parameter, such as optical density (OD₆₀₀), cell count (CFU), or log₁₀ CFU. The x-axis represents time or concentration. The plots show various growth curves, including exponential, stationary, and lag phases, and data points representing experimental results. The factors being tested include different media, temperatures, and concentrations of various substances.

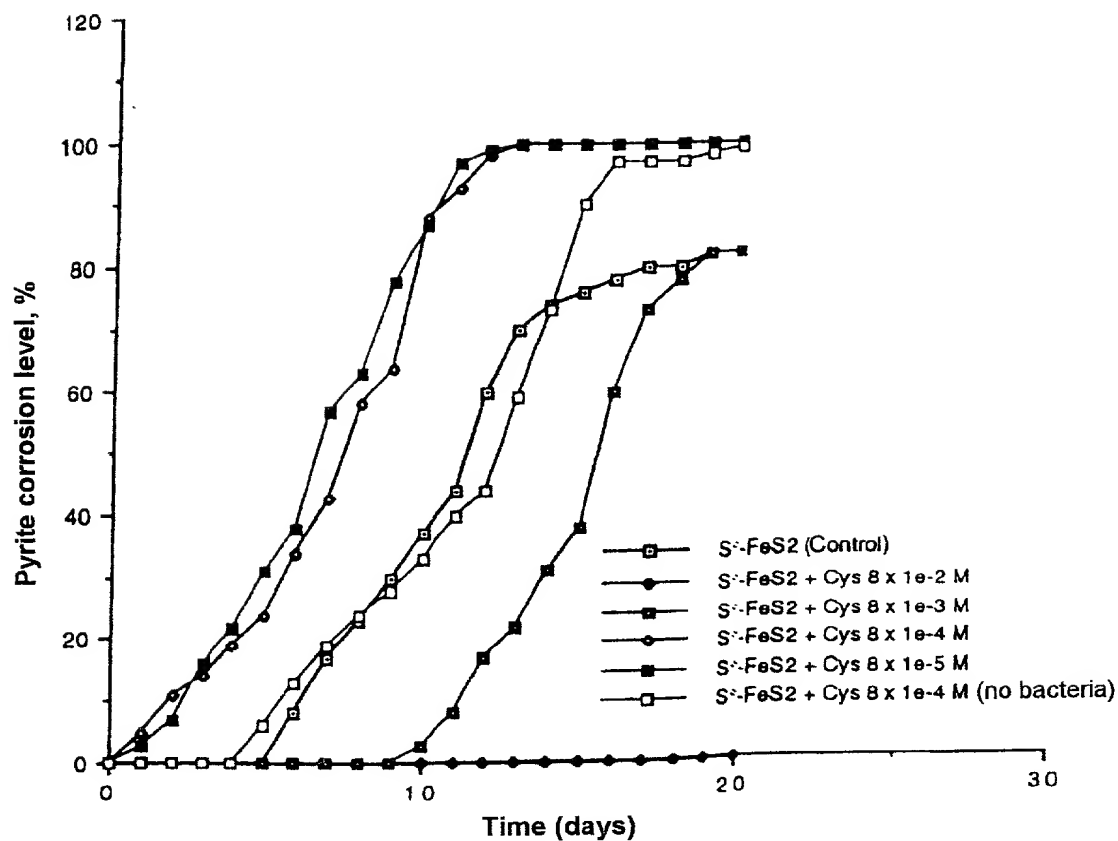


Fig. 1: Relationship between bacterial pyrite corrosion, cysteine concentration, and exposition period.

BIRCH, STEWART, KOLASCH & BIRCH, LLPP.O. Box 747 • Falls Church, Virginia 22040-0747
Telephone: (703) 205-8000 • Facsimile: (703) 205-8030PLEASE NOTE
YOU MUST
COMPLETE THE
FOLLOWING**COMBINED DECLARATION AND POWER OF ATTORNEY
FOR PATENT AND DESIGN APPLICATIONS**

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated next to my name; that I verily believe that I am the original, first and sole inventor (if only one inventor is named below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Insert Title:

A PROCESS FOR THE MICROBIAL LEACHING OF SULFIDIC MATERIALS, AND THE USE OF SULFUR-CONTAINING AMINO ACIDS IN SAID MICROBIAL LEACHINGFill in Appropriate
Information -
For Use Without
Specification
Attached:

the specification of which is attached hereto. If not attached hereto,
the specification was filed on January 30, 2001 as
United States Application Number 09/744,809 ✓
and amended on January 30, 2001 (if applicable) and/or
the specification was filed on July 23, 1999 as PCT
International Application Number PCT/EP99/05272 ✓; and was
amended under PCT Article 19 on _____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I do not know and do not believe the same was ever known or used in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representative or assigns more than twelve months (six months for designs) prior to this application, and that no application for patent or inventor's certificate on this invention has been filed in any country foreign to the United States of America prior to this application by me or my legal representatives or assigns, except as follows.

I hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d) of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)**Priority Claimed**Insert Priority
Information:
(if appropriate)

<u>198 36 078.9</u> (Number)	<u>Germany</u> (Country)	<u>July 30, 1998</u> (Month/Day/Year Filed)	<input checked="" type="checkbox"/> <input type="checkbox"/> Yes No
<u> </u> (Number)	<u> </u> (Country)	<u> </u> (Month/Day/Year Filed)	<input type="checkbox"/> <input type="checkbox"/> Yes No
<u> </u> (Number)	<u> </u> (Country)	<u> </u> (Month/Day/Year Filed)	<input type="checkbox"/> <input type="checkbox"/> Yes No

I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States provisional applications(s) listed below.

Insert Provisional
Application(s):
(if any)

<u> </u> (Application Number)	<u> </u> (Filing Date)
<u> </u> (Application Number)	<u> </u> (Filing Date)

All Foreign Applications, if any, for any Patent or Inventor's Certificate Filed More than 12 Months (6 Months for Designs) Prior to the Filing Date of This Application:

Insert Requested
Information:
(if appropriate)

Country	Application Number	Date of Filing (Month/Day/Year)
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>

I hereby claim the benefit under Title 35, United States Code, §120 of any United States and/or PCT application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States and/or PCT application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information which is material to the patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

Insert Prior U.S.
Application(s):
(if any)

<u> </u> (Application Number)	<u> </u> (Filing Date)	<u> </u> (Status - patented, pending, abandoned)
<u> </u> (Application Number)	<u> </u> (Filing Date)	<u> </u> (Status - patented, pending, abandoned)

I hereby appoint the following attorneys to prosecute this application and/or an international application based on this application and to transact all business in the Patent and Trademark Office connected therewith and in connection with the resulting patent based on instructions received from the entity who first sent the application papers to the attorneys identified below, unless the inventor(s) or assignee provides said attorneys with a written notice to the contrary:

Raymond C. Stewart	(Reg. No. 21,066)	Terrell C. Birch	(Reg. No. 19,382)
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PLEASE NOTE:
YOU MUST
COMPLETE
THE
FOLLOWING:

Full Name of First
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Insert Name of
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Address

Full Name of Second
Inventor, if any:
see above

Full Name of Third
Inventor, if any:
see above

Full Name of Fourth
Inventor, if any:
see above

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

GIVEN NAME/FAMILY NAME		INVENTOR'S SIGNATURE	DATE
José ROJAS-CHAPANA		<i>[Signature]</i>	05.04.
Residence (City, State & Country)		CITIZENSHIP	
Berlin, Germany DEX		Chile	
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Brunnenstr. 129, 13355 Berlin, Germany Herrfurthstr. 20A, 12049 Berlin/Germany			
GIVEN NAME/FAMILY NAME		INVENTOR'S SIGNATURE	DATE
Helmuth TRIBUTSCH		<i>[Signature]</i>	05.04.
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MAILING ADDRESS (Complete Street Address including City, State & Country)			
Alsenstr. 24, 14109 Berlin, Germany			
GIVEN NAME/FAMILY NAME		INVENTOR'S SIGNATURE	DATE
Residence (City, State & Country)		CITIZENSHIP	
MAILING ADDRESS (Complete Street Address including City, State & Country)			
GIVEN NAME/FAMILY NAME		INVENTOR'S SIGNATURE	DATE
Residence (City, State & Country)		CITIZENSHIP	
MAILING ADDRESS (Complete Street Address including City, State & Country)			

*DATE OF SIGNATURE